PCT / SE 2004 / 0 0 1 6 5 6

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REGISTRERINGSVERKET • PAT.

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(21) Patentansökningsnummer *0303031-9*
Patent application number

(86) Ingivningsdatum *2003-11-12*
Date of filing

Stockholm, 2004-11-19

För Patent- och registreringsverket
For the Patent- and Registration Office

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Inter-frequency and inter-RAT handover measurements

FIELD OF THE INVENTION

The present invention relates to performing measurements for inter-frequency and inter-RAT handover while receiving MBMS-data in a point-to-multipoint scenario.

BACKGROUND OF THE INVENTION

The work item Multimedia Broadcast Multicast Service (MBMS) is currently being standardised for release 6 within 3GPP. There are two modes of point-to-multipoint (ptm) operation defined, the broadcast and the multicast mode.

The specifications require that it shall be possible that performance requirements on mobility procedures shall not be altered when a user equipment (UE) is receiving ptm MBMS data. How the UE is supposed to perform inter-frequency and/or inter-RAT (Radio Access Technology) measurements during ptm-reception of MBMS data shall therefore be clearly described in the standard, as it is not possible for a UE to perform such measurements while listening to MBMS contents on FACH, unless it is equipped with dual receivers. Similarly, it shall be ensured that pages are not lost while inter-frequency/RAT measurements are performed concurrently to ptm MBMS data reception.

DETAILED DESCRIPTION OF THE INVENTION

Currently, there is no solution standardised that allows to perform inter-frequency and inter-RAT measurements while receiving MBMS. UEs would either not perform measurements during MBMS reception, which impacts mobility, or the UE

would prioritize the measurements over the MBMS reception, resulting in loss of MBMS data and excessive retransmissions. Since all UEs receiving MBMS share a common downlink there is no possibility for UTRAN to have individual measurement occasions for each UE, when there is no downlink transmission for that UE, as in R'99. This is because the number of MBMS users in a cell are assumed to be very large, and there will be no possibility to coordinate this between all UEs without loss of MBMS transmission capacity. The basic idea is to either leave the control of measurement occasions to the UE or align the MBMS measurement occasions between all MBMS UEs. Leaving it to the UE is covered by the DRX scheme. Aligning the measurement occasions are covered by the DTX or Compressed mode scheme.

In general, measurements occasions could be scheduled in two different ways: either autonomously by each UE, or by the UTRAN. The following describes three possible alternatives to enable measurements during MBMS data reception:

A first alternative refers to DRX during FACH reception. In this scheme, the UE shall individually decide when to perform inter-frequency/RAT measurements, provided performance requirements on cell reselection are met. Note that whether measurements are performed in a serie of smaller parts (similarly to DCH compressed mode), or in a longer pass, shall be left to the UE implementation. Obviously, MBMS data loss will occur when the UE tunes to another frequency/RAT. If no mechanism for recovering the lost packets is provided by UTRAN, this will result in a number of transport block errors, which could in the worst case lead to a large amount of point-to-point (ptp) repair requests. Although this may be acceptable under certain circumstances, we do not believe this will provide a robust radio interface for MBMS.

Outer coding on the radio layer or on the application layer can be used in order to compensate for losses due to bad radio conditions. If DRX on FACH is used, outer coding on radio layer can be used to compensate for the data loss during the DRX occasions. Outer coding, e.g. Reed-Solomon code, will encode a number of inner code blocks (in case of radio layer outer coding, a number of TTIs), add some parity information that is used to recover inner code block errors. For instance, with a RS (16,12) code, 12 inner code blocks (TTIs of 80 ms) would be encoded into 16 TTIs, i.e. 33% overhead would be added. This overhead will increase the bitrate to be transmitted over the radio from, e.g., 64 kbps to 85 kbps, which will result in an increase of Node B transmit power requirements. Note that this overhead from outer coding will need to be spent on all MBMS UEs, regarless whether they have one receiver (requiring DRX) or dual receivers (not requiring DRX).

However, UEs with dual receivers will be able to perform the measurements without data loss and will therefore experience a better QoS (better streaming performance, less download delay). It should also be noted that the use of an outer code (either on radio or application layer) will improve the performance for the end-user, since e.g. exceptionally bad radio conditions may occasionally lead to lost transport blocks.

This alternative implies the advantage that it is simple, does not require extra signalling, and does not have impacts on the S-CCPCH (Secondary Common Control Channel) according to previous standardisation releases within 3GPP. Further, there is no need of paging rescheduling for idle or PCH UEs, as measurements could be performed between paging occasions. Advantageously, UEs in FACH could perform such measurements during "FACH measurement occasions", whereas UEs in DCH could utilize compressed mode gaps. This way, MBMS data loss will be minimized. The alternative requires lower link performance and error-recovery mechanism necessary, e.g. outer coding.

A second alternative relates to DTX during FACH transmission. In this scheme, UTRAN shall not send any MBMS data during predefined time intervals. Note that this could lead to DTX periods on the S-CCPCH, if no other FACH transmission (non-MBMS or other MBMS service) is scheduled during the DTX period. As the S-CCPCH is not power controlled, long transmission interruptions could be considered, e.g. up to a whole TTI (80 ms). In order for the CRNC to be able to handle a constant bit rate of incoming MBMS data, data received during "idle" intervals shall be locally buffered in the RNC, and later on send when MTCH transmission is resumed. This means that the MTCH rate in the TTIs that are transmitted shall be slightly higher for DTX than for DRX (thus leading to a small

transmit power increase in the Node B), in order to compensate for idle periods. For instance, if one TTI of 80 ms is to be skipped every 4 seconds, the data rate during the transmitted TTIs would be increased by 2%.

Idle MTCH (or S-CCPCH) periods shall not be indefinitely repeated with a periodicity equal to 2^N, N = 3 .. 9, in order not to block paging for idle or PCH UEs whose paging occasions fall on those intervals. Solutions could either be to specify a somewhat regular DTX pattern (e.g. in the form 2^N) overlapping paging occasions in a "sliding" way (e.g. an SFN cycle counter could be used for that purpose), or to define an "irregular" DTX pattern (i.e. not in the form 2^N) irrespective of the SFN cycle. This way, and whenever the paging occasion for a UE to be paged would be "unavailable", paging could be rescheduled to the next paging occasion (thus at the expense of the call establishment delays).

This scheme may not prevent FACH UEs running "FACH measurement occasions" nor DCH UEs in compressed mode from loosing MBMS packets (assuming such measurements occasions to be (also) utilized by the UE to tune to another frequency/RAT), i.e. a repair mechanism would need to be provided as well. Advantageously, there is no packet loss for idle or PCH Ues. This alternative implies no impact on previous standardisation releases according to 3GPP. However, this alternative will require buffering in the RNC and also imply a slight Tx power increase in the Node B. It will be necessary to signal idle periods to all Ues, e.g. broadcasted on system info and a PICH rescheduling is needed. "FACH measurement occasions" for UEs in FACH, or compressed mode UEs in DCH may imply an additional packet loss, which can make error-recovery mechanisms necessary, e.g. outer coding.

A third alternative relates to compressed mode on S-CCPCH. This alternative intends to create "idle" periods during MBMS transmission while performing inter-frequency/RAT measurements is to introduce compressed mode on S-CCPCH. Conversely to compressed mode on dedicated channels, which is so far covered in 3GPP, a number of special procedures can be omitted for S-CCPCH, as power control is not used.

In principle, a simplified compressed mode method could be used for the S-CCPCH, e.g. spreading factor reduction, however at the expense of the Node B transmit power, as Tx power would have to be doubled during the compressed frames. However, is must be noted that no data buffering would be needed in this case.

Similarly to the DTX scheme, paging availability shall be enforced, either through PICH rescheduling or by introducing modified PICH channels. Transmission gaps could be created in the PICH in a way that they overlap with transmission gaps on S-CCPCH. Modified PICH frames could be obtained by allocating a PICH on a SF 128 code, but using only 288 out of 600 bits for the transmission of the paging indicator bits. Furthermore, note that PICH rescheduling would be needed as well, in order not to transmit PCH when an overlap with a transmission gap on the S-CCPCH would occur. This alternative does not imply any packet loss for idle or PCH Ues. However, there will be a need to prevent UEs according to previous standardisation releases within 3GPP from selecting the compressed S-CCPCH. There is also a need to signal compressed mode information to all Ues, e.g. broadcasted on system info and there is a need for PICH rescheduling. "FACH measurement occasions" for UEs in FACH, or compressed mode UEs in DCH may imply an additional packet loss, which can make error-recovery mechanisms necessary, e.g. outer coding.

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/SE04/001656

International filing date: 12 November 2004 (12.11.2004)

Document type: Certified copy of priority document

Document details: Country/Office: SE
Number: 0303031-9
Filing date: 12 November 2003 (12.11.2003)

Date of receipt at the International Bureau: 07 December 2004 (07.12.2004)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)